

Southwest Fisheries Science Center
Santa Cruz Laboratory
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August 28, 2003 F/SWC3:KAB

CRUISE REPORT

VESSEL: NOAA R/V DAVID STARR JORDAN, DS 03-04

CRUISE DATES: MAY 12 - JUNE 13, 2003

PROJECT: Rockfish Recruitment Assessment,
Groundfish Analysis Team, SWFSC - Santa Cruz, CA

BACKGROUND:

Rockfish (*Sebastes* spp.) are an important component of both the recreational and commercial fisheries off the west coast of North America. In recent years, significant reductions in the biomass of many of these species have been observed. The reductions likely stem from a combination of heavy fishing pressure and poor recruitment due to poor survival of larvae within the first few weeks of life. Adult rockfish are often unavailable to commercial fishing gears until they are 3-7 years old, so a preview of future recruitments can be valuable in modeling population growth and determining allowable harvest levels. It is difficult to assess the abundance of younger rockfish due to the inaccessible habitats where they live. However, a part of their early life history involves a pelagic juvenile stage that allows them to be sampled effectively. Since 1983, personnel from the Groundfish Analysis Team of the NOAA NMFS Santa Cruz Laboratory (formerly the NOAA NMFS Tiburon Laboratory) along with the NOAA Ship DAVID STARR JORDAN have conducted annual surveys off central California to assess the spawning success and future recruitment of over 2 dozen rockfish species.

ITINERARY:

LEG I: May 12 - May 29, 2003

The annual juvenile rockfish survey began in Monterey Bay on May 14, 2002 after the Ship transited from San Diego, CA and embarked scientists, a commercial Fisherman, and gear via RHIB just outside of Santa Cruz Harbor. Beginning the night of May 14 and ending the early afternoon of May 29 the Ship and scientists conducted Mid-Water trawling, CTD deployments, and Bird/Marine Mammal observations at standard sampling stations between Cypress Point (Monterey County) and Point Reyes (Marin County). At the end of leg I the Ship docked at Pier 27 in San Francisco the morning of May 29, one day earlier than planned due to a mechanical problem. One day was spent in port on May 30.

LEG II: May 31 - June 13

Embarked scientists May 31 and departed Pier 27 at 1600. The first night was spent finishing sweep 2 with mid-water trawls inside the Gulf of the Farallones. Continued with third sweep of juvenile rockfish survey beginning the night of June 1 until the morning of June 8. Exchanged one scientist at Half Moon Bay on June 4. Exchanged five scientists at the end of sweep 3 at Half Moon Bay the morning of June 8. Beginning the morning of June 8 and ending the Morning of June 11, ancillary projects were conducted. The ancillary projects included acoustic EK500 transects along the continental shelf slope, Tucker trawls to ground-truth the acoustic transects, and experimental nighttime mid-water trawls. Disembarked scientists and scientific equipment at Pier 27, San Francisco the morning of June 11. The Ship departed Pier 27 shortly thereafter and returned to San Diego with an arrival to homeport on June 13.

OBJECTIVES:

1. To determine the distribution and abundance of juvenile rockfish between Cypress Pt. and Pt. Reyes, CA and their relationship with oceanographic conditions (temperature, salinity, currents, chlorophyll, etc.).
2. To characterize prominent biological and physical oceanographic features.
3. To map the distribution and abundance of krill along the continental shelf break between Point Reyes and Monterey Bay.
4. To observe seabird and marine mammal distribution and abundance.
5. To determine swimming speeds of captured, young of the year, pelagic juvenile rockfish.

METHODS:

1. Juvenile Rockfish Survey:

In general, 5-7 midwater trawls are conducted each night between 2100-0500 PST. Standard trawl stations are sampled during three distinct “sweeps” of the survey area with all trawl stations being fished once per sweep. Each sweep last from 7 to 10 days/nights. A total of 21 successful nights of trawling are needed to complete the annual survey. The trawl stations remain in the same location and are sampled in a consistent manner from year to year. There are 35 standard mid-water trawl stations of fixed geographic locations. Following is a list of the trawl stations along with the geographic location for each station, the depth of the bottom at the station, the estimated trawl warp to be used for that station’s trawl, the station’s ID number, the target headrope depth for each station, and the designated geographic Strata for the station.

Juvenile Rockfish Survey Trawl Stations

Latitude Deg Min	Longitude Deg Min	Depth(m) of Bottom	Warp (m)	Station#-Depth Identifier	Headrope Depth (m)	Geographic Strata
36° 50.8'	121° 59.0'	92	75	119-2	30	MI
36° 46.0'	121° 52.0'	73	75	114-2	30	MI
36° 44.4'	121° 58.6'	238	75	116-2	30	MI
36° 42.5'	121° 54.5'	92	75	115-2	30	MI
36° 38.5'	121° 51.5'	37	25	111-1	7	MI
36° 39.3'	121° 56.8'	73	75	112-2	30	MI
36° 35.0'	122° 10.5'	2300	25	110-1	7	MO
36° 35.0'	122° 10.5'	2300	75	110-2	30	MO
36° 35.0'	122° 10.5'	2300	215	110-3	100	MO
36° 35.0'	122° 2.0'	530	75	109-2	30	MO
36° 38.8'	122° 3.0'	915	75	113-2	30	MO
36° 42.0'	122° 6.5'	1920	75	117-2	30	MO
36° 46.4'	122° 9.0'	915	75	118-2	30	MO
36° 59.0'	122° 17.5'	82	75	123-2	30	SS
36° 59.0'	122° 22.5'	128	75	124-2	30	DS
36° 59.0'	122° 25.5'	457	75	125-2	30	DS
36° 59.0'	122° 35.5'	400	75	126-2	30	DS
36° 59.0'	122° 45.5'	1060	75	127-2	30	DS
37° 16.5'	122° 34.0'	82	75	131-2	30	SS
37° 16.5'	122° 39.0'	95	75	132-2	30	SS
37° 16.5'	122° 49.0'	165	75	133-2	30	DS
37° 16.5'	122° 59.0'	550	75	134-2	30	DS
37° 16.5'	123° 09.0'	1000	75	135-2	30	DS
37° 39.5'	123° 2.5'	120	75	152-2	30	DN
37° 39.5'	123° 12.5'	1240	75	154-2	30	DN
37° 44.6'	123° 8.3'	90	75	156-2	30	SN
37° 53.0'	123° 19.0'	90	75	160-2	30	SN
37° 53.0'	123° 30.0'	1460	75	162-2	30	DN
38° 10.0'	123° 29.0'	400	75	171-2	30	DN
38° 10.0'	123° 22.0'	183	75	170-2	30	DN
38° 10.0'	123° 17.0'	128	75	168-2	30	DN
38° 10.0'	123° 10.0'	90	75	167-2	30	SN
38° 9.5'	123° 5.0'	73	75	166-2	30	SN
38° 10.0'	123° 0.0'	55	25	165-1	30	SN
37° 47.5'	122° 52.0'	55	25	139-1	30	GF
37° 42.0'	122° 54.5'	55	25	138-1	30	GF
37° 35.8'	122° 49.9'	55	25	237-1	30	GF

Figure 2 illustrates the survey's standard trawl and CTD stations.

Target headrope depths and warp length are specified by the dashed number following the trawl station ID number, where the number -1 indicates a target depth of 7 meters using 25 meters of warp, number -2 indicates a target depth of 30 meters using 85 meters of warp, and number -3 indicates a target depth of 100 meters using 215 meters of warp. Example ~ Trawl Station-Depth ID "166-2" has a target headrope depth of 30 meters and 75 meters of warp will be used to fish at that depth. Target headrope depths, while trawling, were achieved and maintained by the amount of wire out for the trawl warps and a constant rate of speed through the water. Variances of +/- 5 meters for the trawl headrope depth during deployment is not a significant issue, but we endeavored to fish as close to the target headrope depth as possible. A Vemco TDR (temperature- depth recorder) was attached to the trawl net headrope during deployments. The Vemco TDR provides retrospective data on headrope depth and seawater temperature at the headrope. The Vemco TDR records this information every 10 seconds. In addition, four SIMRAD ITI acoustic sensors (trawl-eye, depth-temp, port wing spread, starboard wing spread) are attached to the headrope and to the net wings near the center of the breast lines during deployments. The SIMRAD ITI provides real-time information on headrope depth, footrope depth, distance between spread sensors, and seawater temperature at the headrope. The SIMRAD ITI information is refreshed on a 30 second interval. During mid-water trawl deployments (setting, fishing, retrieving), the Ship's speed is maintained at 650 RPM (2 knots, speed through the water). For a target headrope depth of 30 meters we used between 75 (minimum) and 95 (maximum) meters of wire out. The exact amount of wire out for the trawl warp is determined after the first trawl of the night from examination of the TDR and SIMRAD ITI data. Heavier weather usually requires more warp. Ship's speed and the length of trawl warp are not altered when the net is fishing at the target headrope depth. The standard duration for fishing the trawl net at the target headrope depths is constant, at 15 minutes. In areas of high jellyfish concentrations, "test" trawl deployments were made with a 5 minute, fishing at target depth, duration. The fishing at target headrope depth begins when the designated amount of warp is out, with winches braked. All aft deck lights were turned off when the net was at target headrope depth so that no lights were visible when the net is fishing at depth. An acceptable standard 30 meter target depth tow normally took 10 minutes to set and 10 minutes to retrieve. The standard tow direction was downwind with following seas dead astern. If both the wind and seas were calm then the tow direction was towards the next trawl station. In high cross currents, the course was altered into or with the current. Fish, shrimp, squid, and krill from each trawl were sorted, identified and enumerated. Juvenile rockfish and salmon were frozen for laboratory analyses. Real-time CTD casts using the port J-frame were conducted throughout the day in the vicinity of the trawl transects and at each trawl station at night. Some CTDs were excluded during daytime and night-time operations in the interests of the time needed to complete planned mid-water trawls. A Seabird Electronics Seacat 19+ CTD was used in conjunction with a Seabird Electronics Model 32/33 Carousel Water Sampling System. The CTD was lowered to a maximum depth of 520 m, as bottom depth allowed. Deployment rate: soak for 2 minutes at 10 meters depth, then beginning at the surface - 45 m/min for the downcast, and 60 m/min for the upcast. Water samples were taken, on average, three times, every 24 hours, for chlorophyll and nutrient analysis. Water samples were collected during the upcast with the Niskin Bottles which are attached to the Seabird carousel.

2. Survey of Prominent Biological and Physical Oceanographic Features:

A Simrad EK500 echosounder was used to acoustically characterize the distribution and abundance of macro-zooplankton and micro-nekton, meroplankton and zooplankton. Acoustic data were collected continuously throughout the cruise. The echo sounder was configured with down-looking 38, 120, and 200 kilohertz (kHz) transducers mounted in the hull. During the survey, the EK500 was configured to transmit pulses every 2 seconds at 1 kilowatt for 1 millisecond duration. Geographic positions were obtained from the ship's GPS and logged every 60 seconds. Ethernet communications were maintained between the EK500 and a Windows based PC which logged the EK500 telegrams using EchoLog software. Data were displayed in the aft lab using Sonardata's EchoView software. An RDI Acoustic Doppler Current Profiler recorded data continuously while underway to determine subsurface current velocity and direction. The hull mounted ADCP recorded horizontal and vertical velocity as a function of depth by using the Doppler effect to measure the radial relative velocity between the instrument and scatterers in the ocean. The CalCOFI ue4m.exe ADCP setup configuration was used to input navigational data from the Ship's GPS and gyrocompass into the ADCP Data Acquisition Software (DAS). The ADCP transmits a ping from its transducer elements roughly once per second. Profiles were produced and displayed on a PC by range-gating the echo signal, which produces successive segments called depth bins. The noisy velocity estimates from each ping are vector averaged into ensembles which are subsequently saved to computer disk. A permanently mounted Seabird thermosalinometer continuously recorded seawater temperature and salinity while underway. The thermosalinometer measures water that is continually pumped from a sea-chest located in the Ship's hull at a water depth of 3 meters. This data was used for comparisons with CTD casts and for estimating oceanographic frontal areas. All the thermosalinometer data was saved to computer disk. A Turner Designs SCUFA fluorometer was configured to record raw chlorophyll data continuously while underway. The fluorometer was bench-mounted with a seawater flow-through system attached. The flow-through seawater was pumped up the laboratory bench-top flow-through system from the Ship's hull at a depth of 3 meters. The chlorophyll data was combined with the Ship's GPS location data via the Ship's SCS and subsequently saved to computer disk.

3. Map the Distribution and Abundance of Krill Along the Continental Shelf Break Between Point Reyes and Monterey Bay:

A series of daytime onshore-offshore transects, each approximately 5nm in length and spaced ~ 1 km apart, were run, during which the Simrad EK500 echosounder was used to record and geo-reference the presence and abundance of krill. Acoustic target identification was periodically determined by deploying a Tucker trawl on areas of heavy backscatter. These operational activities were conducted near the end of the cruise (June 8-11) after all three sweeps of midwater trawls for pelagic juvenile rockfish had been completed.

4. Seabird and Marine Mammal Observations:

Ornithologists from PRBO Conservation Science (formerly Point Reyes Bird Observatory) were aboard during Leg I. Ornithologists from the H. T. Harvey & Associates Ecological Consultants were aboard during sweep 3 of Leg II. The ornithologists estimated the distribution and abundance of seabirds and marine mammals while underway. The ornithologists used standardized population censusing techniques to survey the marine birds and marine mammals. Observers censused birds continuously from the Ship's flying bridge during daylight hours

while the vessel was underway at speeds of 7 knots (9 km /h) or greater. A range-finder was used to estimate the width of the survey transect and only those birds sighted within a 300 meter arc from the bow (directly ahead) to 90 ° off the side with best visibility (e.g., least glare) were logged into a field computer. Ship-following birds were recorded the first time they were detected and were ignored thereafter. The observers estimated the range to marine mammal sightings and recorded them, regardless of their perpendicular distance to the vessel.

5. Determine Maximum Swimming Speeds of Captured, Young of the Year, Pelagic, Juvenile Rockfish:

The pelagic juvenile rockfish which survived after captured with the mid-water trawl were retrieved as quickly as possible from the catch and placed in dark opaque containers with lid, in fresh seawater with gentle aeration for 10- 15 minutes for recovery. Swimming experiments were carried out using a three channel experimental swimming flume (c.f. Stobutzki and Bellwood 1997). This apparatus consisted of a perspex chamber divided into 3 channels, with flow straighteners at the mouth of each channel to produce laminar flow. A 270 liter per minute(lpm) 2.4 Kw Ongaä pump circulated seawater through the system and a gate valve calibrated using angles (and therefore current speed). Calibration was carried out for the slower speeds by recording the volume of water passing through the chamber over a set time period for different angles on the protractor. Recorded volumes were divided by the sum of the cross sectional area of the each channel to determine speed. Calibration at faster speeds was provided by an in-line flow meter. Fish were placed in each channel and allowed to acclimatize briefly before the start of the experiment. The speed was then increased by 3 body lengths per second bls^{-1} intervals every two minutes, until the fish could no longer maintain its position in the channel. The critical swimming speed (U-crit) or maximum swimming speed of juvenile rockfish was calculated as: $U\text{-crit} = U + (t / t_i * U_i)$, where U is the penultimate speed, U_i is the velocity increment (2 cms^{-1}), t is the time swum in the final velocity increment and t_i is the set time interval for each velocity increment (2 minutes).

Results:

1. Juvenile Rockfish Survey:

A total of 118 midwater trawls were conducted at night during the three sweeps. In relation to the 21 year history of this project we observed lower than normal catches of juvenile rockfish, with a total juvenile rockfish catch (956) similar to what was caught from 1994-1997 . Catches this year were also much lower than last year's, although many of the fish were large, a condition usually associated with good survival. The abundance of shortbelly rockfish (*Sebastes jordani*), which dominated catches in the late 1980s, continued to decline. This was the third lowest year of the 21 year cruise history for shortbelly catches, with only the extremely strong El Nino/La Nina years of 1998 and 1999 having lower catches of shortbelly. Conversely, this year's catches of brown rockfish (*Sebastes auriculatus*) were much greater than typical. As was seen last year, the sizes of the juvenile rockfish were much greater than what was observed in the 8 years previous to 2002.

Marine scientists from the University of California at Santa Cruz also participated in the cruise in order to research the abundance and feeding behavior of market squid and to collaborate with the NMFS Santa Cruz Lab scientists on krill identification and abundance from the mid-water trawl and EK500 acoustic transects operations. The number of young market squid caught in the

midwater trawls was relatively low compared to previous cruises. In Comparison to last year, there was less squid caught. This year there were 1693 *Loligo* sp. caught in 35 out of 118 hauls, while last year there were 8721 *Loligo* caught in 58 out of 85 hauls.

214 successful CTD casts were made during the cruise. Seawater samples were collected at depth during several CTD casts per day. Samples of seawater from the CTD casts were frozen for nutrient analysis and 200 ml of each water sample was immediately filtered for chlorophyll/fluorometer calibrations.

Several southern California species of invertebrates were captured in the trawl net, namely krill and spiny lobster larvae. Anecdotal evidence such as this along with the comparatively lower levels of surviving juvenile rockfish and lower levels of young market squid give evidence of possible mild El Nino conditions during the winter and spring off central California. Late April rainfall and strong southerly air flow occurred 3 weeks prior to the cruise, which may have also caused advection of southern California species into central California.

Table 1 lists the species of juvenile rockfish caught during each sweep of the cruise. Table 2 lists the total numbers of juvenile rockfish caught during the cruise and on similar cruises from 1986 to 2003.

The biomass of rockfish stocks has decreased along the west coast of North America, and the fishery has been declared a disaster. The decline is partially due to a long series of poor recruitments during the 1990s. Fishery managers are now faced with setting fishery quotas that will minimize economic hardships while rebuilding these fish stocks. In regards to rockfish which comprise many of the species in the Groundfish Management Plan for the West Coast, this survey provides a three to seven year advance assessment of recruitment strength for rockfishes and other groundfish. Knowledge of recent and future recruitments allows more accurate stock assessments, rebuilding analyses, and management projections, helping fishery managers in setting optimal harvest levels.

2. Biological and Physical Oceanographic Data Collections:

Contour charts of near surface seawater temperature, salinity, and chlorophyll will be produced and analyzed for subsequent publication. Calm wind conditions the first 2 weeks of May and the last 2 weeks of the cruise was conducive to phytoplankton patchiness. Near-surface Chlorophyll levels showed much variability with strong pulses off of Pt. Reyes and Bodega Bay where chlorophyll concentrations were the highest ever recorded during this cruise since these measurements first began in 1997. Phytoplankton near the surface exhibited strong patchiness throughout the cruise period, except during a week of strong upwelling favorable conditions during sweep 2, indicating somewhat ubiquitous mixing in the surface layers over the continental shelf.

Acoustic data were collected throughout the cruise using the Simrad EK500. Approximately 2.5 gigabytes of data were collected during the cruise. The data are being used for various studies cooperatively between the NOAA NMFS Santa Cruz Lab and the Ocean Sciences Department of the University of California at Santa Cruz, which include: 1) acoustic target identification and differentiation, 2) krill abundance and distribution.

3. Map the Distribution and Abundance of Krill Along the Continental Shelf Break Between Point Reyes and Monterey Bay:

Acoustic data are being used for various studies cooperatively between the NOAA NMFS Santa Cruz Lab and the Ocean Sciences Department of the University of California at Santa Cruz, which include: 1) acoustic target identification and differentiation, 2) krill abundance and distribution. From June 8 until June 10, acoustic transects were conducted at 5 km intervals over the continental shelf break from the Monterey Bay Canyon to outer shelf break of the Gulf of the Farallones. One Tucker trawl was deployed during these transects for ground-truthing the acoustic targets. An acoustic transect was also conducted along a tight grid just south of the central traffic separation lanes of the San Francisco Bay entrance during the day on June 10. Six Tucker trawls were deployed during this time for ground-truthing of targets.

4. Seabird and Marine Mammal Observations.

During Sweeps 1 and 2 trained observers from PRBO Conservation Science (formerly Point Reyes Bird Observatory) used standardized population censusing techniques to survey the distribution and abundance of marine birds and cetaceans in the study area. Seabird and marine mammal surveys covered a study area extending northwards from Monterey Bay to Point Arena (250 km), and 100 km across the shelf and the slope (depth > 2000 m). This area was surveyed during May 14 – 28. Overall, 732 marine mammals and over 19,009 birds were observed during 15 days and approximately 1400 km of survey effort. Overall, sooty shearwaters (*Puffinus griseus*) and Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) were the most numerous species, accounting for 72.6% and 47.5% of all the seabirds and marine mammals sighted, respectively. The next most abundant species were common murre (*Uria aalge*; 6.7% of all birds), western gull (*Larus occidentalis*; 4.8%), and phalaropes (*Phalaropus fulicarius*, *P. lobatus*; 3.8%), humpback whale (*Megaptera novaeangliae*; 20.5% of all mammals), California sealion (*Zalophus californianus*; 11.9%), and Dall's porpoise (*Phocoenoides dalli*; 9.3%). During Sweep 3 (May 31 - June 8) observers working for H.T. Harvey and Associates used standardized population censusing techniques to survey the distribution and abundance of marine birds and cetaceans. A total of 29 species of seabirds were identified to species. Of the total number of birds counted (11,490), 51% were sooty shearwaters (5886), 23% were common murres (2680), 16.7% were Cassin's auklets (1923), 2.8% were western gulls (331), 2.4% were California gulls (277), 0.89% were rhinoceros auklets (102), 0.6% were black-footed albatross (73), 0.5% were pink-footed shearwaters (57), 0.14% were Xantus murrelets (16), and 0.1% were Ashy storm petrels (11). Eleven species of marine mammals were identified and of the total number of mammals counted (589), 56% were Pacific white-sided dolphins (328) and 27% California sea lions (158), 6.5% were humpback whales (38), 3% were northern fur seals (18), 3% were Dall's porpoise (18), 1.8% were Steller sea lions (11), 1% were harbor porpoise (6), and 1% were harbor seals (7). Also sighted were two sea otters, one blue whale, one gray whale, and 29 blue sharks. Extensive, large patches, windrows, and fronts of Velella velella were encountered at the sea surface throughout the cruise region.

5. Swimming Speeds of Captured, Young of the Year, Pelagic, Juvenile Rockfish:

Sporadically, during night-time mid-water trawl deployments, several juvenile rockfish survived well enough so that the swim channel experiments could be carried out on them. Below is a graph of maximum swimming speeds of 8 juvenile rockfish species used in the swim channels.

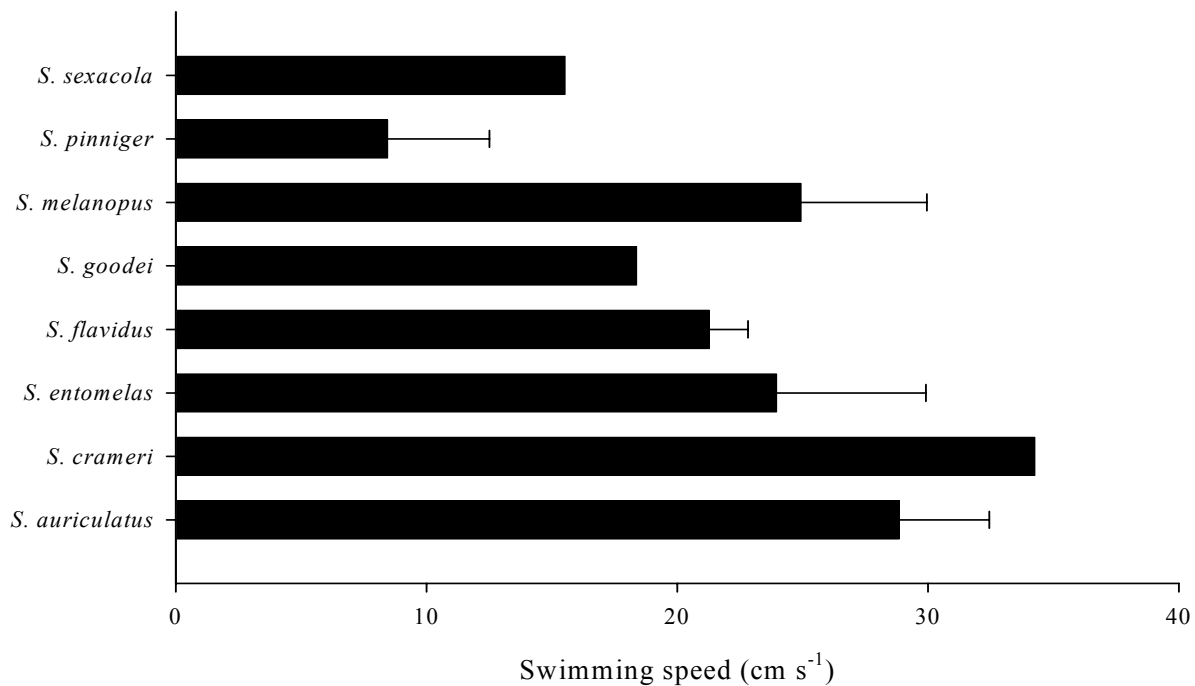


Figure 1. Maximum swimming speeds (U-crit) of 8 species of rockfishes captured outside of Monterey Bay

DISPOSITION OF DATA:

1. Juvenile rockfish, CTD, SIMRAD EK500, chlorophyll, thermosalinometer, ADCP, data and profiles - Keith Sakuma, NOAA NMFS, 110 Shaffer Road, Santa Cruz CA 95060
2. Juvenile salmon specimens and data - Bruce MacFarlane, NOAA NMFS, 110 Shaffer Road, Santa Cruz, CA 95060
3. Seabird and marine mammal data - (Sweeps 1 and 2) Bill Sydeman, Point Reyes Bird Observatory, 4990 Shoreline Hwy, Stinson Beach, CA 94970; (Sweep 3) David Ainley, H.T. Harvey and Associates, 3150 Almaden Expressway, Suite 145, San Jose, CA 95118

SCIENTIFIC PERSONNEL:

Leg I (May 12 - May 29)

Sweep 1 (May 14 - May 22)

Stephen Ralston, Fish Biol, NMFS-Santa Cruz, CA (Chief Scientist)
Ken Baltz, Oceanographer, NMFS-Santa Cruz, CA (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS-Santa Cruz, CA
Don Pearson, Fish Biologist, NMFS-Santa Cruz, CA
John Field, FATE Post-Doc, NMFS-Santa Cruz, CA
Tom Ghio, Commercial Fisherman, Moss Landing, CA
Nancy Gong, UC Santa Cruz, Santa Cruz, CA
Heidi Fish, Fish Biologist, NMFS-Santa Cruz, CA
Rebecca Fisher, Ecology - Post Doc, NMFS-Santa Cruz, CA
Howard Newman, Howard Newman Co., Los Angeles, CA
Cornelia Oedekoven, PRBO Conservation Science, Stinson Beach, CA
Louise Blight, PRBO Conservation Science, Stinson Beach, CA

Sweep 2 (May 22 - May 29)

Ken Baltz, Oceanographer, NMFS-Santa Cruz, CA (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS-Santa Cruz, CA
Don Pearson, Fish Biologist, NMFS-Santa Cruz, CA
Edward (EJ) Dick, Fish Biologist, NMFS-Santa Cruz, CA
Jon Goin, JIMO-Fish Biologist, NMFS-Santa Cruz, CA
Nancy Gong, UC Santa Cruz, Santa Cruz, CA
Lisa Wertz, CA Dept. of Fish & Game, Belmont, CA
Florian Koch, SFSU-Romberg Center, Tiburon, CA
Cornelia Oedekoven, PRBO Conservation Science, Stinson Beach, CA
Louise Blight, PRBO Conservation Science, Stinson Beach, CA

Leg II May 31 - June 13)

Sweep 3 (May 31 - June 8)

Ken Baltz, Oceanographer, NMFS-Santa Cruz, CA (Cruise Leader)
Keith Sakuma, Fish Biologist, NMFS-Santa Cruz, CA
Don Pearson, Fish Biologist, NMFS-Santa Cruz, CA
Edward (EJ) Dick, Fish Biologist, NMFS-Santa Cruz, CA
Alec MacCall, Fish Biologist, NMFS-Santa Cruz, CA
John Reum, UC Santa Cruz, Santa Cruz, CA
Diane Haas, CA Dept. of Fish & Game, Monterey, CA
Carol Keiper, Ornithologist, H.T. Harvey and Associates
David Ainley, Ornithologist, H.T. Harvey and Associates

Ancillary Survey (June 8 - June 11)

Stephen Ralston, Fish Biol, NMFS-Santa Cruz, CA (Chief Scientist)

Ken Baltz, Oceanographer, NMFS-Santa Cruz, CA (Cruise Leader)

Keith Sakuma , Fish Biologist, NMFS-Santa Cruz, CA

Baldo Marinovic, UC Santa Cruz, Santa Cruz, CA

Kerrie Pipal, JIMO-Fish Biologist, NMFS-Santa Cruz, CA

Steve Gough, Humboldt State University, Arcata, CA

Diane Haas, CA Dept. of Fish & Game, Belmont, CA

Brycen Swart, JIMO-Fish Biologist, NMFS-Santa Cruz, CA

Standard Trawl and CTD Station Locations

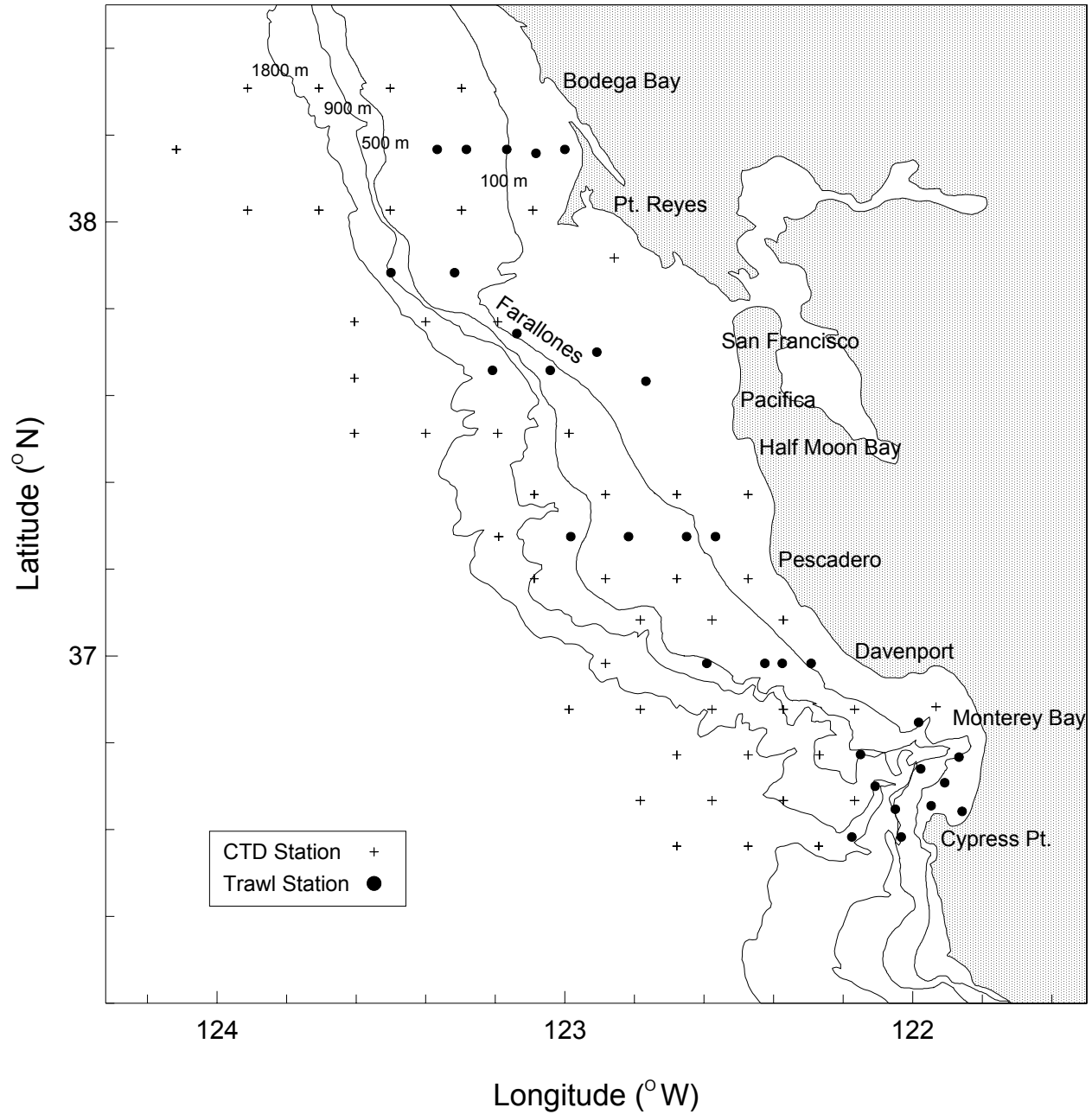


Figure 2. Standard Sampling Stations for the Juvenile Rockfish Survey

Table 1. Juvenile Rockfish Catches by Sweep During the Cruise

Species (common name)	Sweep 1	Sweep 2	Sweep 3	Total
Sebastes auriculatus (brown)	57	12	26	95
S. crameri (darkblotched)	1	1	1	3
S. entomelus (widow)	20	117	90	227
S. flavidus (yellowtail)	2	31	35	68
S. goodei (chilipepper)	31	44	10	85
S. hopkinsi (squarespot)	0	1	0	1
S. jordani (shortbelly)	33	104	69	206
S. levis (cowcod)	0	1	0	1
S. melanops (black)	4	9	10	23
S. mystinus (blue)	13	72	55	140
S. paucispinus (bacaccio)	1	0	1	2
S. pinniger	4	22	5	31
S. saxicola (stripetail)	3	7	8	18
S. wilsoni (pygmy)	0	6	2	8
Sebastes spp unknown	15	18	12	45
Sebastomus spp	0	3	0	3
Totals	184	448	324	956

Table 2. Number of Pelagic Young-of-the-Year Rockfish Collected by Midwater Trawl at Standard Stations During May-June Cruises (1986-2002)

SPECIES	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03
Shortbelly	9104	6865	107962	1598	4479	2422	2838	2287	949	276	1848	784	69	124	2016	3403	995	206
Chilipepper	54	586	4418	24	66	343	90	1251	3	32	17	12	3	27	27	126	286	85
Brown	470	10	-	3	19	265	7	1226	15	5	32	2	-	2	5	117	58	95
Widow	11	424	257	13	296	623	1	101	24	25	-	49	1	81	80	193	858	227
Squarespot	4	177	380	16	649	47	70	25	2	-	-	1	-	-	-	36	16	1
Canary	46	71	162	39	23	618	-	14	3	-	-	3	-	38	9	31	258	31
Blue	4	196	366	63	38	220	3	38	11	7	4	5	-	9	10	67	341	140
Stripetail	2	194	30	6	22	175	5	315	9	6	2	27	14	31	11	185	352	18
Bocaccio	327	106	60	22	44	114	5	26	4	3	1	7	1	15	24	51	71	2
Yellowtail	22	85	69	31	27	281	5	31	8	27	3	6	6	1	10	30	58	68
Copper complex	9	9	1	-	1	15	116	82	54	7	10	42	4	2	4	25	5	-
Halfbanded	1	9	-	2	77	8	1	5	2	-	6	68	-	1	-	96	7	-
Pygmy	2	15	9	12	10	62	8	2	3	-	1	2	-	1	3	34	37	8
Black	1	22	19	5	4	34	-	6	2	7	7	-	1	5	1	2	29	23
Olive	-	4	2	6	18	-	-	6	1	-	-	-	-	-	-	13	5	-
Darkblotched	-	7	5	-	1	9	-	9	-	2	-	-	-	2	1	1	6	3
Cowcod	1	17	1	1	-	-	5	5	-	-	-	-	-	-	-	-	2	1
Bank	-	18	4	-	-	-	-	5	-	-	-	-	-	-	1	1	3	-
Sebastomus	2	7	3	-	1	3	8	-	-	1	2	27	-	-	2	2	2	3
Splitnose	1	4	-	-	1	-	19	-	-	-	-	10	-	1	3	-	-	-
Puget Sound	-	-	-	-	-	18	-	-	-	-	-	-	-	-	-	-	-	-
Sharpchin	-	-	-	-	-	-	2	-	14	-	-	-	-	1	-	1	3	-
Grass	1	1	-	-	-	-	8	2	1	-	-	-	2	-	-	3	-	-
Quillback	2	1	-	-	-	6	-	-	2	-	1	-	-	-	-	-	-	-
Vermillion	-	4	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Copper	-	-	-	-	-	-	1	-	-	-	6	-	-	-	-	-	-	-
Greenspotted	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Aurora	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Unknown	40	5	-	-	2	4	49	31	13	13	31	49	14	25	29	55	2	45
Totals	10104	8837	113748	1841	5779	5290	3242	5467	1120	411	1971	1095	115	366	2236	4472	3394	956